Enhancing Livelihood of Tribal Farmers of Sikkim through Integrated Organic Farming System: A Case Study

Boniface Lepcha[1], Ravikant Avasthe[2], Raghavendra Singh[3] and Pallabi Phukan
1.SMS (Hort.), KVK, Ranipool, Sikkim, 2. Joint Director and 3. Sr. Scientist (Agronomy & 4. SMS (Agril. Ext.)
ICAR, Research Complex for NEH Region, Sikkim Centre, Tadong, Sikkim

Corresponding author e-mail: yenob79@gmail.com

ABSTRACT

Sustainable agriculture means an integrated approach to increasing farm yield and managing resources in order to address all three critical aspects of sustainability: economic, environmental and social. ICAR-KVK, East Sikkim has adopted the Integrated Organic Farming Systems (IOFS) approach to stabilize income streams through natural resource management and livelihood diversification in tribal village at Timpyem, East Sikkim. The salient features of IOFS include – innovation in farming for maximizing production through optimal use of local resources, effective recycling of farm waste for productive purposes, community-led local systems for water conservation, organic farming, and developing a judicious mix of income-generating activities such as dairy, poultry, piggery, vermicomposting and others. ICAR-KVK, East Sikkim built farmer capacities for adoption of productive, remunerative, eco-friendly and self-sustaining integrated farming in the village. The economic indicators clearly showed that the net returns from the recommended practices were substantially higher than the farmers practices during the demonstration period. Overall yield enhancement by the recommended technological intervention under IOFS was 16.07 per cent over the pre intervention yield. Overall B:C ratio of technology was recorded as 1.9 whereas farmers' practice paved only 1.6.

Key word: Economic, Enterprise, Organic Farming, Sustainability, Yield.

The economy of Sikkim is linked with agriculture that serves as the source of livelihood and economic security for the sizeable native population. The growth, however, has been restricted because of biotic and abiotic factors. It is estimated that over 80 per cent of the rural population of Sikkim depends on agriculture and allied sectors for economic, food, and nutritional security. The agricultural systems practiced in Sikkim are integrated with nature that has evolved through years of experimentation by the farmers. A marginal improvement in the lifestyle of the farmers has been witnessed with the adoption of modern technologies. Sikkim has some inherent strength that largely supports organic farming. The policies and programmes on organic farming, in tune with our natural endowments envisage making Sikkim a Model Organic State. The march towards organic farming has led to substantial departmental interventions. A large number of initiatives have been taken by the Agriculture and Horticulture Departments of the state. Major crops grown are maize, rice, wheat, millet, buckwheat, pulses, barley and oilseeds. The state is totally a hilly state and the agro climatic conditions range from sub-tropical to alpine condition in higher reaches. No single crop or variety of crop suits all the elevations. Even though agriculture is crucial to the economy of the state it is largely rain-fed with traditional system of cultivation

and low level inputs. Although rainfall in the state is quite high but due to inadequate effort in harnessing the available resource the area under the irrigation is hardly about 11%. The productivity in Sikkim is lower than both the regional and national averages for all the major field crops. Increasing per unit productivity will be the key in bridging this gap which can be achieved with area expansion under high yielding varieties along with proper package of practices that will exploit the inherent production potential of varieties designed for organic farming from the local gene pool; soil-test values based nutrient management and appropriate plant protection measures. Low cropping intensity in Sikkim is primarily due to low available soil moisture after the cessation of long rainy season from mid February to October end, low awareness of technological options to utilize residual moisture and utilization of harvested, stored rain water using micro irrigation systems and persistence with conventional practices resulting in low yielding production systems. Since Sikkim enjoys as many as 8 agro-climatic zones with varied distribution of rainfall and soil texture, hence there is enough scope to grow a variety of horticultural and field crops throughout the year in four different districts with different topographic features. As per the Human Development Report – 2001, in Sikkim, diversification in the land use pattern has to be taken into account for both food security and livelihood sustainability. The limitations of terraced farming in terms of productivity and the dearth of land for cultivation highlight the constraints faced by the farming community for livelihood security. Under these conditions innovative scientific technologies in the potential sectors like horticulture and livestock can be identified and explore the most pressing constraints and best possible opportunities for the growth of the farming sector.

East District is the main economic district of Sikkim state with geographical area of 954 sq. km. The total population of the district is 2,44,790 as per Census 2011. It is the hub of all administrative activity in the state. The district has 3 sub-divisions, 4 major towns, 120 revenue blocks, 14 forest blocks, 273 panchayat wards and 50 panchayat units. The economics of the district is linked with agriculture that serves as source of livelihood and economic security of sizable local population. The growth, however, has been restricted because of biotic and abiotic factors. It is estimated that more than 70 per cent of rural population depends on agriculture and allied sectors for economic, food and nutritional security. The majority of the farmers of the district fall in small and marginal category. The farmers of the district practice mixed farming. Farmers depend on agriculture, horticulture and animal husbandry for their livelihood.

A small tribal village Timpyem of 44 farming families with total population 161 persons (male: 54.03%, female: 45.96%) was identified in East district located at $27^0$33’94” N Lat and $88^0$60’29” E Long to assess the technologies developed by ICAR Sikkim Centre (Now ICAR-

NOFRI). Participatory rural appraisal revealed that the village was approximately 87% literate and farming was the only income for 32 farm families under marginal category and 3 landless farm families. Maize/rice based cropping systems with traditional methods were practiced. . Livestock viz., cattle, pig, goat and poultry with a population of cattle 45 nos., pig 22 nos., goat 27 nos., and poultry 397 nos. provided supplementary income. The net income from the agriculture produce and livestock in the village was around Rs 12,750 per household per annum. The farmers of the village suffered from the acute shortage of marketing linkage in the region and ultimately sold their products at low price through middlemen. The village faced shortage of organic farming inputs including quality seeds. Insect pest and diseases infestation were the most common problems under organic condition. Therefore, in order to enhance the cropping intensity of the state the best possible resource conserving technologies and other suitable technological interventions through Integrated Organic Farming System under Tribal Support Plan were demonstrated in participatory mode by the ICAR-NOFRI and KVK-East Sikkim, Ranipool, East Sikkim during 2014-16.

METHODOLOGY

Considering the physical, social and economic limitations of Sikkim, an integrated farming system model was demonstrated in Timpyem village, East district of Sikkim during 2014-15. Various technologies for increasing the productivity of the existing conventional farming system were introduced to 44 nos. of farming families in 5.55 ha land. With the assistance of Tribal Sub-Plan, technological interventions were detailed by providing training, on field demonstrations and input support. Various inputs/interventions were provided under the project with the purpose of reorienting their traditional farming into integrated organic farming system (IOFS) to increase the farm income. Major technologies included low cost water storage structure, *Jalkund* using silpaulin (250 GSM), low cost plastic tunnels (transparent UV stabilized sheet of 45 GSM) for sequential vegetable cultivation, zero till vegetable pea, mustard, cole crops, buckwheat were introduced in the village. Strengthening backyard poultry production with Vanaraja, scientific method of piggery and dairying, hybrid Napier cultivation as fodder grass on terrace risers were also mediated. High yielding varieties of cereal crops like maize (Vivek Sankul-31) and rice (VL-86) were introduced. Similarly, high yielding varieties of vegetables *viz*., cabbage var. Rare Ball, cauliflower var. Suhasini, broccoli var. tomato var. Arka Samrat, coriander var. Super Midori, spinach var. All Green, radish var. Chinese White were sequentially cultivated under low cost plastic tunnels. *Jalkund*, water reservoir was designed with dimensions of 5 m × 4 m × 1.5 m (capacity of 30,000 l.) was introduced to meet the water requirement of crops through

gravitational sprinkler irrigation system and encouraged the farmer to opt for diversification of the integrated organic farming system. Marketing of farm produce was linked with Farmers' Produce Organization of the district also been intervened by the Institute.

RESULTS AND DISCUSSION

Capacity building of the farmers through institutional intervention changed the farmers' attitude and motivated the farming community to adopt improved technological options developed by ICAR-NOFRI (earlier ICAR Sikkim Centre). Interventions raised the productivity of maize and rice to 3860 kg/ha and rice 2470 kg/ha as compared to 2435 kg/ha and 2320 kg/ha, respectively. Similarly, total rice production increased 22.80 tonnes from 6.2 ha of land during 2016-17 as compared to pre-intervene 12.65 tonnes. Area under zero-tillage system for vegetable pea, mustard, cole crops and buckwheat was about 4.56 ha in the village during Rabi season which remained fallow in earlier years. Garden pea (Kashi Uday) under zero-till in rice-fallow rotation recorded higher productivity (6125 kg/ha) as compared to conventional tillage with Local cv. Dentame (4532 kg/ha). Vegetable crops were cultivated in sequence (Broccoli-Radish-Methi-Coriander-Palak) under low cost poly tunnel system with a benefit cost ratio of 4:1. Eight numbers of low cost water harvesting structure (*Jalkund*) demonstrated in the village encouraged the farmers to opt for diversification in cultivation of vegetable crops during Rabi season with the cultivation of cole crops, potato, vegetable pea, fenugreek, coriander etc. Average productivity of Rabi vegetable crops was 6250 kg/ha after interventions whereas, it was only 5250 kg/ha during 2015-16. Interventions were also made in dairy farming with low cost shed for improved management. Higher green fodder was made available during the lean period in the village with cultivation of hybrid napier and oat on the terrace risers and stony terraces. Piggery was improved in the village with the introduction of high yielding crossbreds (Hampshire x local) and low cost shed. The Institute initiated backyard poultry farming system with Vanaraja variety. Farmers were given hands on training programme and distributed around 1750 nos. of days old chicks during the intervention period. Proper housing, feeding and disease management of the birds resulted in early maturity. The average body weight gain in 3 months was 1.36 kg and egg laying started at the age of 5 months. Average egg production of the Vanaraja was recorded at 128 numbers per bird in the village. Farmers of the village managed to sell the birds at the rate of Rs. 300/- per kg and Rs. 12/- per egg and therefore, backyard poultry farming supplemented income generation for livelihood improvement. Total earning from Vanaraja backyard poultry was in the range of Rs. 85200 to 95500/- in the village. The recycling of farm

and house waste through compost making in Sipaulin Vermi Bed system and used as manure also increased the soil fertility and reduced the weed infestation in the village.

The yield performance and its related economic indicators presented in Table 1 reveal that average yield of maize, rice, buckwheat, kharif vegetables, rabi vegetables were recorded from 24.35, 19.20, 10.5, 52.38, 52.5 q/ha respectively. The yield enhancement by the recommended technological interventions was 25.3, 22.3, 14.8, 14.5 and 16.00 percent higher than the pre intervention yield. Various economic indicators like gross expenditure, gross returns, net returns and benefit: cost ratios of the demonstrations are also presented in Table 1. The economic indicators clearly show that the net returns from the recommended practices were substantially higher than the farmers' practices during the demonstration period. Mukherjee (2003) reported that the innovative interventions had superior implications in enhancing productivity. The average net returns of maize, rice, buckwheat, kharif vegetables, rabi vegetables from the recommended practices were much higher than the income before intervention *viz*., Rs. 18650 (pre intervention Rs. 4425), Rs. 11840 (pre intervention Rs. 9450), Rs.27020 (pre intervention Rs. 19940), Rs.41920 (pre intervention Rs. 31980), Rs.63250 (pre intervention Rs. 49050). The benefit: cost ratio of the recommended practices and farmers' practice were 1.2 and 1.5, 1.2 and 1.3, 1.6 and1.8, 1.8 and 2.1, 1.9 and 2.2, respectively. Mishra *et al*. (2009) in potato, Sharma (2003) in moth bean and Gurumukhi and Mishra (2003) in sorghum have reported similar findings.

Similarly the performance of backyard poultry (5.24 q/ha), dairy cattle (8665lit.), piggery (13.68 q/ha) were recorded before the intervention of technologies (Table 1) and after technological interventions; the performance increased to 5.90, 9750, 15.80 with 11.2%, 11.1%, 13.4% incremental changes. Accordingly, the economic indicators like gross expenditure, gross returns, net returns and benefit: cost ratios of demonstrations also improved over farmers practice (Table 1) *viz*., Rs. 95,500 (pre intervention Rs. 85,200), Rs. 62,370 (pre intervention Rs. 47,850), Rs.1,39,720 (pre intervention Rs. 1,12,350). The benefit: cost ratio of the recommended practice and farmers practice were 2.2 and 2.6, 1.5 and 1.8, 1.6 and 1.9, respectively. The village is now developed as Integrated Organic Farming System model for the entire farming community of East Sikkim district as well as whole Sikkim. Farmers from other villages motivated by the success of the village and headmen of neighboring villages are encouraging farmers to implement similar models in their villages. These interventions have the potential to create positive impact on the utilization of scarce resources under the fragile mountain ecosystem

benefitting the farmers at large. Overall B:C ratio of technology was recorded as 1.9 whereas farmers' practice showed only 1.6.

Table 1: Economics of the crops and livestock under IOFS in Timpyem village

Crops/Enterprise	Average (q/ha)		% increased	Gross cost (Rs./ha)		Gross income (Rs./ha)		Net income (Rs./ha)		B:C Ratio	
	Pre - intervention	Post - intervention		Pre - intervention	Post - intervention	Pre - intervention	Post - intervention	Pre - intervention	Post - intervention	Pre - intervention	Post - intervention
Crops											
Maize	24.35	32.60	25.3	32100	39250	36525	57900	4425	18650	1.2	1.5
Rice	19.20	24.70	22.3	36950	37560	46400	49400	9450	11840	1.2	1.3
Buck wheat	10.50	12.32	14.8	32560	34580	52500	61600	19940	27020	1.6	1.8
Kharif vegetables	52.38	61.25	14.5	42590	44650	78570	91875	31980	41920	1.8	2.1
Rabi vegetables	52. 50	62.50	16.00	55250	60850	107300	131100	49050	63250	1.9	2.2
Animal husbandry											
Back yard poultry	5.24	5.90	11.2	55695	62050	140895	157550	85200	95500	2.2	2.6
Dairy cattle (lit.)	8665	9750	11.1	125450	132630	173300	195000	47850	62370	1.5	1.8
Piggery	13.68	15.80	13.4	161250	176280	273600	316000	112350	139720	1.6	1.9

CONCLUSION

The economic indicators clearly showed that the net returns from the recommended practices were substantially higher than the farmers practices during the demonstration period. Overall yield enhancement by the recommended technological intervention under IOFS was 16.07 per cent over the pre intervention yield. Overall B:C ratio of technology was recorded as 1.9 whereas farmers' practice paved only 1.6. High benefit:cost ratio also advocated the economic viability of the demonstration and motivated the farmers towards adoption of interventions demonstrated. The suitable technology for enhancing the productivity of all possible components of Integrated Organic Farming System, and need to conduct such demonstrations may lead to economic improvement and empowerment of farmers under organic conditions. It will also provide impetus to the diversification programme of the state government, besides increasing the cropping intensity in the state.

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Vegetable seedlings production under Tunnel system at Timpyem.

Vegetable pea in rice-fallow under no-till condition

Progressive farmer Smt. Penki Lepcha of Timpyem sharing her view during training programme.

Cultivation of Broccoli under Tunnel system at Timpyem.